

### Claims

1. A two layer metal palladium - or palladium alloy - composite membrane consisting of a porous substrate support and a palladium - or palladium alloy - membrane characterized in that the palladium metal substantially exists on the outer surface of the porous substrate support with little or no presence in the pore channels of the substrate.
2. A process for the preparation of a two layer metal palladium - or palladium alloy - composite membrane consisting of a porous substrate support and a palladium - or palladium alloy - membrane characterized by the following consecutive steps;
  - 1) Rinsing/washing and drying the porous substrate support,
  - 2) Treating the porous substrate support with a pore filler in order to decorate the pores of the support and, optionally, the disfigurements of the substrate surface,
  - 3) optionally, when an excess of pore filler resides on the substrate support surface, cleaning the substrate support in order to remove this excess of surface pore filler,
  - 4) sensitising and activating with a palladium solution the decorated substrate support,
  - 5) plating the resulting support with a palladium solution to form the two layer composite membrane,

- 6) drying, and
  - 7) optionally, subjecting the resulting composite membrane to a post-processing where the pore fillers residing in the pore-channels of the porous substrate are removed or reduced in volume through either heating or physical/chemical dissolving.
- 5
3. A process according to claim 2 characterized in that in step 2 is performed under vacuum, preferably by immersing the porous substrate in a solution of pore filler in order to ensure that the pores and, optionally, the disfigurements of the substrates are preoccupied with the filler and that there is no palladium ingress into the pores during 10 the consecutive preparation steps.
  4. A process according to any of claims 2 to 3 characterized in that in step 4 the porous substrate support is sensitised in  $\text{SnCl}_2$  solution and activated in  $\text{PdCl}_2$  solution, respectively.
  5. A process according to any of claims 2 to 4 characterized in that in step 5 the 15 porous substrate is immersed in a electroless plating solution.
  6. A process according to claim 5 wherein the electroless plating solution has the typical composition of  $[\text{Pd}(\text{NH}_3)_2]\text{Cl}_2$ ,  $\text{EDTA}\cdot 2\text{Na}$ ,  $\text{NH}_2\text{-NH}_2\cdot \text{H}_2\text{O}$ ,  $\text{NH}_3\cdot \text{H}_2\text{O}$ .
  7. A process according to any of claims 2 to 6 characterized in that the post-processing step 7 is mandatory.
- 20
8. A process according to claim 7, wherein the composite membrane is dried and then calcined at least 300 °C.
  9. A process according to any of claims 2 to 8 characterized in that the pore fillers used have a particle size lower than 0.2 micron, preferably lower than 0.1 micron, more preferably lower than 0.05 micron.
- 25
10. A process according to any of claims 2 to 9 characterized in that the surface pore fillers are chosen amongst gels, sols, colloids or precipitates.
  11. A process according to claim 10 wherein the pore fillers are chosen amongst Al-sol, Si-sol, Ti-sol, Zr-sol and/or Ce-sol.
  12. A process according to claim 10 wherein the pore fillers are chosen amongst

13. hydroxide-colloid, alkali carbonate colloid and/or carbonate colloid.
14. A process according to claim 10 wherein the pore fillers are chosen amongst hydroxide-precipitates, alkali carbonate precipitates and/or carbonate precipitates.
15. A two layer metal palladium - or palladium alloy – composite membrane obtainable by any of claims 2 to 13.
16. A composite membrane according to claim 1 or 14, or a preparation process according to any of claims 2 to 13 characterized in that the porous substrate support is selected from one of the following porous materials; porous stainless steel, porous nickel, porous glass or porous ceramics.

10

15

20

25